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Science and Art Gossip.

A CORRESPONDENT, writing from Scarborough, makes some fun out of our Gossip note about a star-like body seen on December 21, in close proximity to the sun, entertaining, apparently, the belief that the object was the planet Venus. The idea is one which is naturally suggested by the description we quoted from a letter addressed to the *Dundee Advertiser*, "the milky-white appearance," and the "crescent shape," when seen with telescope,—but a little consideration would have shown our humorous correspondent that as Venus was in transit on December 6, she could not have been in close proximity to the sun at noon on December 21. As a matter of fact she was then 1 h. 33 m. in R. A. west of the sun (corresponding to an arc distance of 23° 15′ in R. A.), in declination 5° 2′ north, making an actual arc distance of about 24 degrees. I would submit that such a distance as this, about forty-four sun breadths, would scarcely be described as "close proximity." See an interesting letter from Mr. J. E. Gore, in our Correspondence Column.

IN the *Bristol Times* for Dec. 20, the following stupendous letter appeared over the name John Large. We commend it to the special attention of the sun-spot craftsmen :—

Please kindly allow me to observe, through the medium of your widely-circulated paper, that the late severe weather was attributable to the transit of Venus through the sun, which I am prepared to prove without any delusive theory, but with practical illustrations if required. Many dark spots have been observed on the sun more or less for the last five or six years, and they have been the cause of the many wet summers which we have unfortunately experienced, although, doubtless, for some wise purpose. But now that Venus has passed triumphantly *through* the sun, and having taken with her all the dark spots and specks which have existed more or less for many years, I venture to predict that we shall be blessed with a series of beautifully fine and productive summers.

THE intense cold of yesterday (Dec. 15), remarks a correspondent of the *Daily Express*, followed by so rapid a thaw, has produced an effect seldom before witnessed in this country. The public buildings, especially those composed of Portland or other absorbent materials, are to-day thickly covered with hoar frost. At Trinity College the old buildings in Botany Bay present a curious appearance, each stone being marked out as if whitewashed, while the joints remain black, the rude arches over the windows showing to great advantage; and the banks and other large edifices look as if they had been lately finished. I would suppose that the frost had penetrated the stone, and the warm mist now falling on it is converted into ice." [The effect is really due to difference of absorptive action.—ED.]

DR. RUSSELL, of the Chemical Laboratory at St. Bartholomew's Hospital, a member of the committee which has been for some time carrying on extensive experiments on the composition of London fogs, at the request of the Meteorological Council of the Royal Society, states that he has already obtained results showing that the increase in the amount of carbonic acid in the air of the City during fogs in some cases amounted to upwards of two and a half times the quantity ordinarily present.

MR. W. H. PREECE, in his paper on "Electrical Exhibitions," read before the Society of Arts, thus summarises his criticisms :—"At South Kensington we had a magnificent collection of the scientific condition of electrical apparatus at that date—1876. At Paris we had an equally magnificent show of their practical condition in 1881. At the Crystal Palace the commercial element stepped in, converting a picture of progress into a means of advertisement; while at Munich science again comes in to fulfil its chief duty—to measure and compare. At Paris and the Crystal Palace medals and honours were distributed, but at Munich the far more sensible plan has been adopted of giving simple certificates of efficiency, showing plainly what each apparatus can do in its own particular sphere. We are about to have not only a second exhibition at the Crystal Palace, but also one at the Westminster Aquarium. These are purely commercial speculations. Vienna is also to have an exhibition in the autumn, and doubtless they will be repeated in all chief cities."

A CURIOUS dispute has arisen in Germany as to an invention connected with the sugar industry. According to an account published in the *Hamburger Nachrichten*, the German National Bank some time ago purchased from Professor Scheibler, of Berlin, for 1,000,000 marks—£50,000—a process for obtaining sugar from molasses by means of strontianite, at the same time securing the right of the first offer of such further discoveries as the professor might make. He has now, it is said, taken out a patent for a new process which renders the previous one almost worthless. The bank has commenced legal proceedings for the invalidation of the new patent, instead of acquiring it by a further expenditure of capital. It has been rumoured that Professor Scheibler will work the patent himself, instead of selling it, thus trying to avoid any serious difficulty.

THERE are now 828¾ miles of water-mains for the supply of London which are constantly charged. Of these the New River Company has 214 miles; Lambeth, 136¾; Southwark and Vauxhall, 117; West Middlesex, 86½; Kent, 85; East London, 85; Chelsea, 67; and Grand Junction, 37½ miles.

DURING a recent tornado in Brewer, Me., a plank was blown with such force against a cistern with wooden walls

an inch and a half thick, that the board, the *Scientific American* says, penetrated some distance through the wall into the water. It was found that the board was wedged in so closely that the water did not leak, and the owner simply sawed the plank off, leaving the wall of the cistern all right.

For making luminous paint the following has been given:—Take oyster-shells and clean them with warm water; put them into the fire for half-an hour; at the end of that time take them out and let them cool. When quite cool pound them fine, and take away any grey parts, as they are of no use. Put the powder in a crucible in alternate layers with flour or sulphur. Put on the lid and cement with sand made into a stiff paste with beer. When dry, put over the fire and bake for an hour. Wait until quite cold before opening the lid. The product ought to be white. You must separate all grey parts, as they are not luminous. Make a sifter in the following manner:—Take a pot, put a piece of very fine muslin very loosely across it, tie around with a string, put the powder into the top, and rake about until only the coarse powder remains; open the pot and you will find a very small powder. Mix into it a thin paint with gum water, as two thin applications are better than one thick one. This will give a paint that will remain luminous far into the night, provided it is exposed to the light during the day.

The members of the Bombay Hunt, says the *Bombay Gazette*, have much to answer for. They have been unconsciously the cause of serious allegations being brought against their gallant countrymen in Egypt. At a critical moment of the struggle, when men's minds were highly strung and their imaginations excited to a feverish pitch, they insisted on having a pack of hounds sent through the Canal *en route* to Bombay. This pack bids fair to become historic. Shortly after it passed Port Said, a son of M. de Lesseps informed his indignant friends in Paris that a pack of bloodhounds had been sent with the British troops to hunt down the Egyptian fugitives. It was only a Frenchman who could have mistaken a fox-hound for a bloodhound. In their version of the affair, the Egyptians were more circumspect. In one of the numbers of *Al Wakaya al Masriyeh*, the *Egyptian Gazette*, published by Arabi's Government, Abdelal reported from Damietta to the Sub-Minister of War that "a ship has been passing through the Canal to Ismailia, filled with a cargo of hunting dogs, to act as scouts for the English soldiers when they go out to fight. We conclude," continued this veracious commander, "from their now having recourse to dogs, that the climax of their ill-success and of their defeat has come." Surely history, which keeps a page for the geese of the Capitol and the hound of Robert Bruce, will not grudge a paragraph for the Bombay Hunt and their "cargo of hunting dogs!"

Describing a visit just paid to the sandstone quarry at Turner's Falls, on the Connecticut River, Massachusetts, Mr. Elias Nason states that workmen are still busily engaged in excavating the bird tracks that have made the quarry geologically famous. The ledge rises 30 ft. or 40 ft. above the river, and consists of thin laminæ of a dark-coloured and somewhat brittle sandstone. On the faces of the slabs are found the tracks, depressed and in relief. They are in general clear cut and very distinct. Some very fine specimens have recently been brought to light. One of them has tracks of an enormous animal, 5 ft. apart, and the tracks themselves (three-toed) are 15 in. long. According to Professor Huxley, who has visited this quarry, an animal making such tracks must have been 25 ft. or 30 ft. in height. Mr. Nason was permitted to take away with him several beautiful specimens, one of which exhibits the delicate tracery of the feet of an insect escaping over the soft mud; another exhibits the ripples of the wave, another the drops of rain, and others have well-defined imprints of the tracks of birds. He also saw the impressions of several kinds of ferns and grasses. Mr. Stoughton, who is working this geological mine, considers some of the largest slabs to be worth from $500 to $1,000; but the cost of excavating them is heavy. The whole region is supposed to have been originally covered by the sea. As the waves receded, birds and quadrupeds whose species are extinct left the impressions of their feet upon the mud, which, hardening into stone, has held them through the ages for the examination of the scientists of the present day. Compared with these tracks as to age, the pyramids of Egypt are but as of yesterday.

A California Tree.—There was recently felled in Lonoma County, California, a tree which cut up as follows. The *Petaluma Argus* says that the details can be relied upon. The standing height of the tree was 347 ft., and its diameter near the ground was 14 ft. In falling, the top was broken off nearly 200 ft. distant from the stump, and up to the point of breaking the tree was perfectly sound. From the tree saw-logs were cut of the following lengths and diameters:—1. 14 ft. long, 9 ft. dia.; 2. 12 ft. long, 8 ft. dia.; 3. 12 ft. long, 7 ft. 7 in. dia.; 4. 14 ft. long, 7 ft. 6 in. dia.; 5. 16 ft. long, 7 ft. dia.; 6. 16 ft. long, 6 ft. 10 in. dia.; 7. 16 ft. long, 6 ft. 6 in. dia.; 8. 16 ft. long, 6 ft. 4 in. dia.; 9. 16 ft. long, 6 ft. 3 in. dia.; 10. 18 ft. long, 6 ft. dia.; 11. 12 ft. long, 5 ft. 10 in. dia.; 12. 18 ft. long, 5 ft. 6 in. dia. It will thus be seen that 180 ft. of this remarkable tree were converted into saw-logs.

A correspondent ("Psychomantis") quotes the following from the *Times* of June 10, 1870, as admirably expressing the value of the novelist to his fellow men:—"The loss of Charles Dickens will be felt by millions as a personal bereavement. Statesmen, men of science, philanthropists, the acknowledged benefactors of their race, might pass away, and yet not leave the void which will be caused by the death of Dickens. They may have earned the esteem of mankind; their days may have been passed in power, honour, and prosperity; they may have been surrounded by troops of friends; but however pre-eminent in station, ability, and public services, they will not have been, like our great and genial novelist, the intimate of every household."

A correspondent, Mr. Henry H. Sparling, sends the following sonnet. Regarding it as addressed, not to the Editor, but to all who share the work of advancing Knowledge, we quote it; but still rather as expressing what we wish to do than what we *have* done:—

"*Let* Knowledge grow!" but not content
With just what by those words is meant,
You *urge* it forward on its course
With all your wealth of mental force,
Learning, and wide experience blent.
Along the toilsome steep ascent,
Up which your readers' steps are bent,
Stand Darwin, Spencer, Mill, and Morse:
"Let Knowledge grow!"
Free from the glamour which is lent
By mystic wandering words anent
The things you teach, you but endorse
That you have fathomed to its source,
And Darkness' veil have widely rent—
"Let Knowledge grow!"

THE BELT CASE.

By RICHARD A. PROCTOR.

OF the personal relations involved in this trial I have nothing to say; they are outside KNOWLEDGE, as they are outside my personal knowledge. But certain highly important general principles are involved which fall within our field; and of these I propose briefly to speak.

In the first place, it is to be noted that the office discharged by *Vanity Fair*, in publicly announcing what was widely whispered in artistic circles, and what it believed to be true, fell undeniably within the duties of such a journal —not among the pleasantest duties, and therefore requiring prompt and ready discharge. In expressing its own belief in the rumours referred to, our contemporary most carefully spoke of them as rumours only, and based all that was said in the way of censure, on the condition that the rumours being true could be substantiated if challenged. I take it that the existence of these rumours was a far more serious matter for Mr. Belt than such public reference to them as gave him opportunity to deny them point-blank and challenge any man to substantiate them. Had this been done, and the challenge either suffered to pass unmet, or, being met, successfully sustained, Mr. Belt would, I conceive, have owed a debt of gratitude to *Vanity Fair*, for giving to "things unsubstantial" such form as would permit of their being grappled with and overcome.

My main point, however, relates to the views advanced by Baron Huddleston respecting the validity of artistic criticism. The opinion of Aristotle respecting the relative worth of public and artistic opinion as to the general value of a work of art, is doubtless sound. Apart from the reasons given by Aristotle, Sir Joshua Reynolds, Froude, and others, works of art are made for the public, and must be judged by the public. Neither, on the one hand, can self-esteem or the friendly feeling of a brother-artist force on the public as good what the general taste (not necessarily sound) rejects as unsatisfying; nor, on the other, will the criticism of censorious, perhaps rival, artists cause the public to reject as unpleasing what it has accepted with approval. But it is also true that the public, unbiassed by personal feelings, is apt to form a sounder general judgment, despite the absence of artistic training, than rival or brother artists.

Besides, the opinion of what may call the artistic public, is generally based on wider considerations than those that guide the artist himself. A man of cultured mind brings to his judgment of a painting or a statue (half unconsciously perhaps) not only a wide study of many paintings and many statues in many different schools (the painter or sculptor being usually a specialist in a single school), but the influence of artistic and literary studies outside mere painting or sculpture. Poetry, history, travel, even music and science, have their influence on his judgment. Yet even here, where Aristotle's opinion is sound enough, it must be admitted that the general public needs artistic training to improve and purify its taste in matters artistic. It is among the misfortunes of art in our day that it too often follows instead of leading the public mind.

But Baron Huddleston went altogether beyond what Aristotle, Sir Joshua Reynolds, and others have said on the subject of professional *versus* public judgment. A man of culture may form a sounder opinion of the general qualities of a work of art than the artist himself, just as I can form a better opinion of the table at which I am writing than upholsterers or cabinet-makers. He may even give the artist useful hints in matters belonging to his art, just as I might (for instance) tell a table-maker that his custom of putting sharp angles to table-legs at the level of the knees is an outrage on common sense, and more provocative of theological remarks (absurd as applied to tables) than any known upholstery practice on the face of the earth. But the man of sense accepts artistic criticism unhesitatingly in such matters as technique, style, quality of work in details, and so forth. I am shown a painting which pleasingly presents a noble landscape; I see that effects of light and shade, distance and nearness, are truly given, the forms correct, the air, the sky, the rocks, and trees, and streams, justly and effectively rendered. It does not trouble me if Mr. Envy (though perhaps an R.A., or A.R.A) says: "It would be a charming picture if the fellow knew how to paint." But if Mr. Experience tells me of defects of execution which must cause the picture before long to deteriorate, finds the painting thin, the method of attaining effects imperfect, shows me that the picture will not bear to be looked at in certain aspects, and so forth, I must accept his judgment, just as I must accept the judgment of a furniture maker who shows that a piece of furniture is unfit for certain purposes which it ought to subserve. And if this is so of such points, much more is it the case in such matters as were submitted to artistic opinion during the Belt trial. To set the opinion of Brown, Jones, and Robinson, cleric, legal, medical, or perhaps mercantile, on questions of touch and style in painting or sculpture, against the judgment of men who have given the best part of their time for years to work involving constant practice in deciding such questions, is surely as absurd as it would be to ask a painter to settle a scientific *crux* (Mr. Brett, for instance, to tell us about the atmosphere of Venus), or to take the opinion of literary guests as to the make of the china on your table, against the verdict of half-a-dozen dealers in china who pronounced it the work of such and such a firm or factory. Any one who knows what modelling in the clay is, will see that the way in which the unanimous verdict of eminent sculptors during the recent trial was finally dealt with, involved an even greater absurdity. A clay bust shall be worked at for hours before your eyes by a tyro, and then the master, passing his fingers lightly over it, will, with a touch here and there, a trifling manipulation of this feature or that surface, give light and life to what before was dull and dead, and every trace of his masterly hand shall be as plain to the practised eye as though he had traced his name upon the clay. Yet Baron Huddleston dealt with this particular point as if the hours during which unpractised eyes saw the work of modelling in progress, removed of themselves "all doubt" about retouching (which often means *creating*) even against the united opinion of all the practised eyes invited to decide the question.

I write without any feeling one way or the other as to the personal matters involved. Mr. Belt or Mr. Lawes may have been grievously wronged or wholly in the right, for aught I personally care, who know neither—(I had almost said for aught I know, but that would not be strictly true). But all who love art, all who appreciate the excellence which great artists give to their work, are interested in rejecting a general rule which is not only opposed to all sound principles of criticism, but to common sense. If Baron Huddleston had told us that *Je suis gagné* is good French for "I have gained," and because he had "no doubt" that Verheyden ought to know French, had rejected the opinion of twenty French writers who asserted the contrary, he would not, to my thinking, have gone more directly counter to sound rules

of judgment than he did on the particular point I have been considering.

How far this error of judgment affected the result is a matter about which I offer no opinion—though of course I have one.

PHOTOGRAPHING THE SOLAR CORONA.*

ASTRONOMERS have long hoped, almost against hope, for a time to come when the solar corona might be seen, even as since 1868 the sun's coloured prominences have been seen, without the aid of a total solar eclipse. Almost against hope, because what is known about the corona shows that its light is far too faint to be discerned directly, so greatly is it overmastered by the light of the sky near the sun, while the method which avails to show the coloured prominences cannot be successfully applied to the corona. We know that, during a solar eclipse, even the brighter part of the corona is only seen a few seconds before totality begins, and can only be discerned for a few seconds after the total phase is past. In the full glory of sunlight it is as hopeless to look for the corona, either with or without a telescope, as it would be to look for a star of the fourth or fifth magnitude without telescopic aid in the daytime. And what a telescope does to make a star visible in the daytime cannot be done for the corona; the star is but a point even when the most powerful telescope is turned on it, and therefore a star looks so much the brighter, not so much the larger, as the illuminating power of the telescope is increased. But an object like the corona, or a comet, or a nebula is magnified in at least as great a degree as the illuminating power is increased, and in yet greater degree when high magnifying powers are used, so that it looks no brighter, only larger; in fact, as some light is always lost in passing through the lenses, the apparent brightness of such objects is always rather reduced when a telescope is used, however greatly the total quantity of light received from them may be increased.

The same is true of the sun's coloured flames, so that it was long regarded as hopeless to look for them at any other time but during the few minutes' duration of total solar eclipse. But spectroscopic analysis, so soon as it was shown that they shine only with special tints, gave the means of seeing them in broad daylight. If we consider how this was done, we shall better understand the difficulty in regard to the corona. We cannot do this better, though that is not the actual manner in which the observation is made, than by considering Newton's familiar experiment on the decomposition of light. In that, light admitted through a circular opening, being dispersed by a prism, cast a long rainbow-tinted image on a screen, this image being really made up of multitudinous images of all the colours, not of the rainbow, which is usually but a diluted spectrum, but of the true solar spectrum. In that long streak there were thousands of images of various tints of red, thousands of orange images, thousands of yellow, green, blue, indigo, and violet images, so many, in fact, that no eye could see where any single image began or ended: all were completely blended together. The light, which, undispersed, would have formed a single circular white image, being spread over a long ribbon-like band of space, was, of course, correspondingly weakened; no part of the spectrum was nearly as bright as the round white spot seen before the prism was interposed. Now, suppose that instead of shining with all the colours of the rainbow, the sun shone only with a certain small number of tints—say, one kind of red only, one kind of orange, and one kind of blue. Then, instead of the rainbow-coloured streak formed by tens of thousands of blended images, there would have been but three images—three circular discs—a red circle, an orange circle, and a blue circle. The light, which before dispersion had formed a single image, would have been weakened in forming three, but not nearly so much as in the actual case, where the long streak formed by multitudinous images was many times longer than the diameter of a single circular image. And any further dispersion, which in the actual case would have correspondingly lengthened the spectrum and weakened its lustre, would only have thrown the three images further apart, leaving their brightness unchanged. This difference actually exists between the white light of the sunlit sky and the light of the sun's coloured prominences. These are masses of glowing gas shining chiefly with one red tint, one orange-yellow tint, and one green-blue tint. If we receive on a screen (or when we receive on the retina as on a screen) the light from the sky over a prominence and the light from that great mass of glowing gas, we are unable to distinguish the shape of the prominence, because its light is quite overmastered by the light of the sky; but when, by means of suitably-arranged prisms, we disperse the light thus received, we weaken the sky-light just in proportion as we increase the dispersion; while we only throw the images of the prominence further apart with each increase of spectroscopic dispersion; so that if only our spectroscope has sufficient dispersive power, the prominence, no longer forced to contend against the whole light of the sky, but only against a small portion of it, becomes discernible on the weakened light of the rainbow-tinted background.

If the corona were of the same nature as the prominences, its form might be rendered discernible in the same way. But, as a matter of fact, only the very brightest part of the corona shines with light of special tints; the greater part of this stupendous solar appendage shines with light of all the colours of the rainbow, though, fortunately, with an excess of light from certain parts of the spectrum, otherwise the success we have now to record would never have been achieved.

We must here make a few remarks respecting ordinary methods of observation, and their failure to show any trace of the corona. It occurred long since to Sir George Airy to receive the image of the sun and surrounding parts of the sky on a smooth white surface, and by removing that part of the surface on which the image of the sun itself fell, and putting there a black surface (as it were "quenching the sun in a black bag") to give the prominences and corona a better chance of being seen. The method failed utterly. It was later suggested that so far as the prominences were concerned, the use of a ruby-tinted medium cutting off all the light except rays of nearly the red tint of the prominences, and the substitution of a smooth red surface for a white one, would greatly help to make them visible. It was further suggested that if, when both devices had been employed, the light received on the coloured card were examined through a spectroscope of suitable power, the whole ring of coloured prominences around the sun might be seen at a single view. And it is worthy of notice that the first coloured prominence ever seen—as a whole—by man, without the aid of an eclipse, was seen by Mr. William Huggins, by the aid of the absorptive power of ruby-tinted glass. But, so far as the corona was concerned, such methods as these had persistently failed.

*From the *Times*.

Recently, however, it occurred to the eminent spectroscopist just named to utilise certain information obtained during the total solar eclipse of May 17 last. It was shown on that occasion that though a large part of the light of the corona gives a continuous spectrum (or, in other words, shines with all the colours of the rainbow), there is an excess of coronal light from near the violet end of the spectrum. This does not help, so far as the spectroscopic method is concerned, because a multitude of images of the corona, of various tints of violet, would not, under spectroscopic dispersion, give a single well-defined image which could be seen and examined. The use of absorptive media, cutting off all, or nearly all, but the violet light, was naturally suggested; but this method failed, chiefly perhaps for the reason noted by Mr. Huggins, that the sensitiveness of the eye for very small differences of illumination by violet light is much less than for similar differences in red, yellow, orange, or green light. But, as photography deals most effectively with violet rays, it occurred to Mr. Huggins to try whether he could not photograph the corona by means of its violet light. He received the image of the sun, and of the region around the sun, on the photographic plate, after the light had been sifted out by a screen of violet (pot) glass, and in later experiments, by a solution of potassic permanganate. The sifting thus effected was more perfect for photographic purposes than for ordinary vision, because such red, orange, yellow, and green light from the sunlit sky as found its way through, though hiding the visual image of the corona, produced no effect on the photographic plates. This arrangement being made, and the image of the sun with a due portion of the sky around it being received on the plate, it was found that the coronal image—or what looked very like the coronal image—made its appearance on no less than twenty of the plates. This appearance does not consist simply of increased photographic action immediately around the sun, but of distinct coronal forms and rays, admitting in the best plates of measurement and drawing. As Mr. Huggins well remarks, "This agreement in plates taken on different days with different absorptive media interposed, and with the sun in different parts of the field" (that is, of the photographic plate), "together with other necessary precautions observed, makes it evident that we have not to do with any instrumental effect." Nevertheless we should be glad to hear that the simple device had been employed of cutting away the portion of the plate on which the sun's image would fall, and thus allowing the rays from the sun himself to pass through, and be received where they could not in any way affect the photographic result. Still, the tests applied are probably sufficient to show that Mr. Huggins has really accomplished the great result he announces. Little reliance can be placed on the agreement between the corona photographed in September last and that seen on May 17, the sun and his surroundings being viewed in such very different directions. But the similarity of structural detail and general character is too marked to be explained by mere coincidence.

If the new method is really the success it seems to be, a most interesting series of discoveries may be expected to follow from its employment. Now for the first time, the corona can be studied from day to day and from year to year. A multitude or interesting questions which hitherto have been asked in vain may now be answered. In clearer skies than ours, and at observatories high above the sea-level, a much greater success than Mr. Huggins has yet obtained may be expected. Even more is to be hoped from the steady progress which photography is making, and the use of improved and more sensitive plates.

HUMANITY AND NATURAL HISTORY.

By RICHARD JEFFERIES.

(*Author of "The Gamekeeper at Home."*)

NATURAL history is natural history no longer. Even the very phrase is passing out of use, having ceased to convey the meaning, which has grown too great for the words. By it was understood a catalogue of plants, a list of animals, a description of fossils. The animal kingdom and the vegetable kingdom were terms in constant use; they seem as antiquated now as the language of Chaucer.

I will go no farther back than my grandfather's bookcase. There were the little thick volumes of Buffon, some broad fragments of Cuvier in folio, the same of Linnæus in smaller blocks, Bakewell's "Geology," Kirby and Spence, a hundredweight and a hundred years of the "Philosophical Transactions," and certain books of botany strictly in Latin, whose authors are still honoured, but I shall not name them, for I detested those particular books beyond measure. This was a very respectable body of such learning for those days, and could not greatly have been improved upon. There is a solid mass of facts—a Silurian system—buried in those books to this hour. Buffon, as sure on all subjects as a gamecock, quick, witty, and pointed, writing in lace ruffles, and bringing crooked refractory nature into trim order and easy sentences, was the father of popularisers. Cuvier's bones were gigantic, and there are superstructures at the present day that rest on them. Linnæus worshipped our golden gorse, and was thenceforth as dear to our hearts as a fairy tale.

Bakewell made a tesselated pavement with a geometrical design of what was then sprawling geology; right or wrong, at least you could see the pieces. Kirby and Spence are at this hour capital story-books for children, so interesting are their insects. I never smoked out a wasp's nest with straw or gunpowder after I read that book. The "Philosophical Transactions" are a queer jumble, but the variety and eccentricity of the topics excite the mind to look about for original ideas. The strictly Latin botanies are sawdust. From these authors, however, who, let it be observed, were for the most part primæval and original in some manner, the book-making naturalists of the last forty years have copied their works.

My grandfather's books were genuine, and went to the full length of the knowledge then existent. They formed a kind of dictionary in which you could find particulars of any creature or thing. Turning to the antelope, its food, locality, and mode of life were accurately described, with its genus and Latin label. Turning to the sparrow, its habits, number and time of eggs were clearly recorded. Insects, fishes, plants, mosses—there was nothing known to be existent that was not described or classified. Few now understand the immense labour Linnæus's system of botany represents. Though another system is now in use, the materials of it are practically Linnæan. What Linnæus effected in botany was carried out by various workers in other departments. Here, then, was a vast storehouse of facts—the accumulations of the ancients down from the days of Alexander the Great's preceptor. Looking at them broadly, the whole might be summed up as definition: The definition of an antelope, of an insect, or a plant. It was an encyclopædia of living creatures—a dictionary. This was natural history as originally intended by the phrase.

There was no idea in it. If you read and read steadily through the entomology, and the conchology, and the ichthyology, all the tomes from end to end, most likely you would recollect something of the camel or the rhinoceros—

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a series of pictures might be formed in the mind; but you would not be the richer by one single idea. A ploughman may walk through a menagerie, and see the lions, and tigers, and the elephant, and will henceforward the better understand the infinity of life on the earth; but he will not possess a single new idea. So with these endless records in my grandfather's tomes: they conveyed nothing. I think the word "idea" carries my meaning better than theory or hypothesis. For my part, I consider that ideas are more valuable than facts, being, indeed, the greatest of all facts. Without an idea, facts are as dead as stones, on which no one can feed. Any one may stumble on a fact as a rabbit may turn up a coin. Only the wisest—or shall we rather say the secularly inspired?—can come, by long penance of thought, on the interpretation called an idea. When ideas came into natural history, it ceased to be natural history, and became philosophy.

Instead of endeavouring to trace the course of events from year to year and from thinker to thinker, till it grew to its present estate, it will serve better in way of contrast to sum in outline what that estate now is. At the central education establishments there are now three principal subjects placed before students. There are no precise terms by which these subjects can be accurately described, because they include so many branches. In effect, they are classics, the utilitarian cycle, and natural philosophy. Of old, classics took the first place, and Latin and Greek distinguished the gentleman and scholar. With recent years and the growing desire to profit by education, what I have called the utilitarian cycle has come so much to the front as to threaten the extinction of the classics. Students go to learn things that will actually be useful to them in life, by which they may secure an income. But yet something more is needed. A student may acquire a knowledge of three or more modern languages, be proficient in the higher arithmetic, and so forth—able, in short, to occupy any position in the official or mercantile world—and yet, if he stopped there, would be quite outside the living thought of the age. Without a knowledge of physical science, and that in a very extended form, he would be, however highly educated in other respects, still a mere clerk. In order, therefore, that the scholar may be able to mingle freely in the learned tone of the time, he is instructed in the elements at least of almost all the sciences. From physiology to botany, from electricity to astronomy, he is supposed to be grounded in everything. Unless he were so, half the allusions in the books and leading publications of the day would have no meaning to him. Again, very many of the best paid and most progressive employments are only open to physicists of some ability—as, for instance, the numerous developments of electricity. To indicate the various causes which have led up to the present aspect is not necessary here. The point is that natural philosophy, physical science, physics, whatever name may be given to the higher form of natural history, is now considered so important as to overshadow the rest. The whole aim of modern education is to make a man think natural science—that is, in other words, to fit him to comprehend the spirit of the time.

For the age thinks natural history in its higher or ideal form, just as former ages have thought metaphysics, or have been sceptical, or full of a revived classicism. It enters into every phase and movement. Physiology, for instance, which is the natural history of the human body, is taught—and rightly taught—to women, and even to children. If any one should object that physiology is not natural history, then *his* natural history is exactly that understood by the phrase in the books on my grandfather's shelves. Sanitation is one of the most powerful movements in our time, and seems likely to gather strength. Sanitation would be impossible without an insight into natural history. Its main object is to dispose of certain deleterious organisms, and if these organisms were not studied, it would be the merest rule of thumb. The germ theory, all the researches of Pasteur, and his experiments in microscopic vaccination, these are the purest natural history. So in surgery, the antiseptic treatment; though, indeed, all surgery which depends on growth is natural history. As for the physician of the nineteenth century, he is purely a naturalist. Theories have disappeared: the one leading idea is to get at what nature needs. Nature, nature! the word is on every lip. Men's lives are saved by natural history. Athletics are based on the results of minute researches into the absorption of food, the repair of tissues, all the processes of life, training being adapted to facilitate it. Except those who return conquerors from war there are none so highly honoured as explorers of unknown regions, such as the interior of Africa, or the Palæocrystic sea at the other extreme, whose work is certainly natural history. Astronomy reaches, indeed, above our earth, but uses the forces with which the earth acquaints us as keys to open the stellar spheres. Then, returning to the earth, astronomy ventures theories as to its origin. Despite the attacks made upon it, the Lyell theory, that existing causes are sufficient to explain existing things and the means by which they become as they are, this great idea still influences the mind of every investigator. Such causes may be seen at work in any pond, or even on the window-pane; the whole idea must have been gathered from an intellectual study of natural history, since natural history presents these causes at every step. An exhaustive account of the multitudinous ways in which natural science influences the mind of the age would be of unwieldy length. Everywhere throughout the Anglo-Saxon world, eager minds are seeking new discoveries in such science literally night and day. Therefore, it is strictly accurate to say that the age thinks natural philosophy, looking to it for guidance, help, and future increase.

To gather the views of all these workers into a focus and express it in a formula may not be without its use. The one central idea which inspires their efforts is this: that every single atom of matter should be employed for the good of the human race. While this motive animates the inquirer, the search is consecrated and the seeker dignified. The reward is certain—it is in the inward consciousness of a great aim, which lifts the spirit, and, like a talisman, transmutes coarse things to preciousness. In our age nothing is holy but humanity. The human being is the one shrine towards which all pilgrims of our latter-day faith toil; the human being of itself, irrespective of race, sex, age, or distinction of good or bad. These are the ethics of natural history. The thing is plain enough to any one who stays a moment to consider; but in the hurry of life and the necessities of business, it is not so obvious perhaps to the many. I want to see it recognised as a truth so great as to be the first lesson of youth, the law of manhood, the chief dogma of the world.

It was said the other day, in the *Times* leader on the fire at Hampton Court Palace, that this collection of pictures is the only one open to the public on Sundays. This is a mistake. Miss North's Gallery at Kew is open on Sundays, and is, moreover, the only picture gallery in the metropolitan district which is so.

A LOGICAL PUZZLE.

BY RICHARD A. PROCTOR.

SEVERAL correspondents find the syllogism quoted in a footnote to our review of Prof. De Morgan's Life as "hard" as De Morgan considered it; and not a few can make, it would seem, "neither head nor tail" of it. I will give it again, with the explanation of it,—which, in my judgment, takes longer in the reading than the syllogism ought to take in interpretation and acceptance.

It runs thus:—

(1) For every Z there is an X which is not Y.

(2) Some Y's are Z's.

∴ Some X's are not Zs.

Surely the conclusion is an obvious one. We are told by (1) that there are at least as many not-Y X's as there are Z's. So that for all X's to be Z's, the Z's must be *all* not-Y's; but some Z's are Y's; therefore all X's are not Z's.

The thing may be put in many ways. Here is another—There are so many Z's which are *not* Y's, and so many which *are* Y's; and as many not-Y X's as there are Z's of both kinds. Now as many of these not-Y X's as there are not-Y Z's *may* be Z's; but the rest cannot be; for all the Z's left are Y's. Thus a certain number of X's are not Z's.

Concrete examples are always better than abstract ones; so let us take a simple concrete example of this syllogism. (Of course such an example is afforded by the passage we quoted from De Morgan's letters; but he is there at some pains to wrap up the absurdity involved by a rejection of the syllogism—the only chance, so far as I can see, of misleading any one who, not being a student of formal logic, is not necessarily a darkened reasoner):—

For every football player there is a non-rowing cricketer. Some rowing men play football; therefore some cricketers do not play football.

If, which I cannot imagine, this last case should perplex anyone, make it still more definite by using numbers, noting that you can use almost any numbers you please:—

There are in all 1,350 football players, and there are 1,350 cricketers who do not row; now, 231 rowing men play football; hence only 1,119 football players do not row; and as there are 1,350 cricketers who do not row, 231 cricketers, *at least*, cannot be football players. In such a case as this no logic is wanted. We see at once that our 1,350 football players are divisible into two lots—the rowers 231 in number, and the non-rowers 1,119 in number; but among cricketers there are 1,350 non-rowers, or 231 more non-rowers than there are among football players; so that there must be at least that number of cricketers in excess of the number of football players.

The reasoning may be generalised thus:—

If there are N Z's of which n are also Y's, so that $(N-n)$, and no more, are not-Y's: then if there are N X's which are not-Y's, only $(N-n)$ of these X's can possibly be Z's; the remaining n X's must of necessity be not Z's.

To prove that there is any use whatever in the syllogism, over the credit of inventing which Sir W. Hamilton and Professor De Morgan disputed, it ought to be shown that in any case whatever (in some *one* case at least), depending on the law supposed to be worth demonstrating, any person of average intelligence would fail to arrive at a just conclusion. But this seems utterly incredible. For instance, if any one were told that among football players a fourth are rowing men, and that there are as many non-rowing cricketers as there are non-rowing and rowing football players together, could he fail to see at once that there are more cricketers than football players, so that some cricketers cannot possibly be football players?

PLEASANT HOURS WITH THE MICROSCOPE.

BY HENRY J. SLACK, F.G.S., F.R.M.S.

DISEASE GERMS.

THE subject of these papers will be varied from one fortnight to another to suit the tastes and amount of experience of various readers. To-day, Disease Germs will occupy us. For a long time it has been thought that a large group of diseases, including many of the most fatal, were produced by specific germs inhaled by the sufferer with the air, drank with some fluid, or deposited on some sore place. Through the researches of Pasteur and others the general facts leading to this theory are now placed beyond doubt, and in several cases a well-trained observer can distinguish one disease germ from another, and an experimenter like Pasteur can prove his conclusion right by inoculating some animal with the germs, and producing in it the expected disease. Experiments of this kind, merely to gratify curiosity, could not be defended, but they have a different character, when, as in Pasteur's case, they are guided by a benevolent purpose, and have enabled him—besides assisting the physician to lessen human suffering—to show farmers how to secure sheep, fowls, and pigs from disorders that occasioned a sad devastation. The non-professional and elementary student cannot expect to do more than form a notion of the sort of things disease germs are and how they act. When one particular organism is said to be the specific germ of splenic disease in sheep, and another of an enteric fever in man, it must not be assumed that either the germs or the diseases are specific in the old and very narrow meaning of the term. This we shall see as we go on. The most common forms of disease germs are those of extremely minute rods—bacteria, or minute round bodies called micrococci (little berries) by no means a good term, as the objects are not really like any berry.

Half-a-dozen Preston salts bottles are convenient things for experiments that will throw some light upon these subjects, although they may not exhibit any actual disease germs, but only some of their more innocent relations, or perhaps objects specifically the same as disease germs, but not in a mischievous condition. Put a little water into four of the bottles, and add to one a pinch of chopped hay; to another a bit of raw meat as big as a small pea; to a third a little dust swept from the walls or floors; put a little milk in the fourth; a little flour paste in the fifth; and a little boiled rice in the last. Place all in a warm room, and watch from day to day. As soon as a thin skin (pellicle) forms in any one, put a drop on a slide, cover with thin glass, and view with a power of about one quarter of an inch, which with a ten-inch tube microscope will magnify about 200 linear with an A or No. 1 eye-piece. The observer is sure to see a large number of very small, straight objects, some quiet, and others moving with a wriggling motion. Some of these may show with that magnification that they are beaded, or contain minute beads, others would show it with a much higher power, and some again are so small and delicate as to defy all attempts to discover structure. After a few days, it is most likely that many rather larger thread-like objects will appear, twisted like corkscrews,

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and swimming vigorously with a spiral motion. They are, in fact, screw-propellers, and as the lower forms of life are very ancient, their ancestors, no doubt, practised that mode of propulsion millions of years before it was imitated by man. After a little while, longer threads will be found, and probably some branching like the mycelium of the moulds. Most of the disease-germs identified by various observers are, more or less, like the smallest of the little rods discernible with a quarter-inch objective.

The use of experimenting with a variety of infusions is two-fold: first, there is a chance of getting a variety of germs; and, secondly, different substances favour the development of different kinds of infusorial creatures. Whenever a sunbeam lights up a swarm of motes, there is sure to be amongst them minute eggs and germs of small plants, animals, and objects that lie on the border-land. Professor Tyndall throws artificial sunbeams of electric light through air in glass vessels, and while motes are visible, life will appear, if the germs amongst them are allowed to settle in fluids that will feed them. When there are no motes, a fluid capable of putrescence, but in which all germs have been destroyed by heat, will remain sweet in the purified air for any length of time. Country air on breezy heaths and downs is comparatively free from motes and germs, and on lonely mountains, in calm weather, none are found. As it is most important in thickly-peopled countries to secure breathing-places that are not contaminated, the greatest care should be taken to stop the robbery of open land by adjacent proprietors. Sandy beaches and chalk downs, for example, are invaluable as sanitoriums and playgrounds, and for enabling winds to send pure air to cities. Pasteur has distinguished small, round bodies producing silkworm disease; little rods producing splenic sheep disease; others generating chicken cholera, which is common on French farms; and lately he has identified an organism which can produce rabies in dogs, and which appears to be the source of the poison conveyed in the bite of mad animals.

In the Department of Eure-et-Loire 85,000 animals were inoculated upon Pasteur's plan in 1882. In the last few weeks 13,000 sheep, 3,500 oxen, and 20 horses were similarly treated without a single accident.

M. Paul Bert has recently injected the blood of a mad dog into a healthy one without communicating the disease. He finds the poisonous microbe to reside not in the secretion of the salivary glands, but in the mucus of the mouth and air passages.

It may be said of these organisms generally that they are capable of growing under different conditions, and sometimes they can be developed under various forms which might be taken to belong to different species. The malignant disease germs can, in certain known cases, and probably in others, either be cultivated so as to preserve their evil power for successive generations, or by supplying them with free oxygen, so that their descendants are less and less poisonous and finally harmless. Inoculation with the milder forms protects against the action of the more virulent. The moulds that will grow in some of the bottles are related to the useful ferments and also to those which produce disease.

In the *Newcastle Weekly Chronicle* for Saturday, the 6th inst., will appear the first of a series of weekly columns on popular science, by Mr. Proctor.

The Editor of Knowledge will lecture on the Star-Depths, at St. George's Hall, Langham-place, on Sunday afternoon, at four o'clock. The lecture will be illustrated with the oxyhydrogen light.

OUR BODIES:

SHORT PAPERS ON PHYSIOLOGY.

By Dr. Andrew Wilson, F.R.S.E.

No. III.—MUSCLES.

On one occasion I asked a class of students who were studying physiology in a popular fashion, what they supposed "muscles" were. The answers I received to my inquiry were more distinguished for their variety than for their correctness. One student said "muscle" was "sinew"; another told me it was "some kind of fibre"; a third said it was "gristle"; and a fourth that it was "some kind of pulp found in the body." Now the students in question were drawn from the ranks of ordinary middle-class society. They were studying physiology with me, not as a matter of business, but as a labour of love, and were attempting, under my guidance, to obtain a broad and general view of the functions and structure of the human frame. (We should bear in mind that physiology is the science of "functions," and that, as such, it is based on a knowledge of "structure.") I may therefore take my former students as a type of intelligent society around us, and I am not far wrong, I fancy, when I add that if I were to ask the readers of Knowledge, head overhead, to return me a plain answer to the question "What is muscle?" I should find only a very small percentage of correct replies. Yet in the appreciation of what muscle *is*, to begin with, lies the key to the understanding of the whole topic. Muscle, in one word is *flesh*. Our muscles are our "flesh," as the muscles of any other animal are its "flesh." What we eat of fish is the muscle of the animal, or rather the collective muscles. Our mutton-chop is the "muscle" of the sheep, as veal is ox muscle in a young condition.

We should never despise homely sources of information. The homelier such means of knowledge are, the better. Here, then, is a readily-accessible source of information concerning the nature of muscle. A slice of cold roast beef lies before me. With the point of my fork I can make out that it consists of things that look to the unassisted sight like coarse *fibres*, but which are really bundles of fibres. This is observation number one. Muscle is made up of fibres, or bundles of fibres, joined together. Next, I can see that in my slice of beef (which represents a *cross* cut of muscle) there is to be perceived a line of division, through which I can separate so much of the beef from the other half, without tearing any of the fibres. Now this second observation shows me that the flesh of the body is not all in one mass. On the other hand, if I were to examine a whole leg of beef I should find that the flesh thereof was grouped into separate portions, each of which is *a muscle*. With the handle of a dissecting scalpel, we can separate out each muscle as a rule from its fellows, and we see that freedom of movement for each muscle is thus secured.

At this stage of our inquiries, we might ask ourselves what, generally, are the uses of muscles. I can enumerate at least five functions which are performed by muscles. Firstly, there are the *common movements* of the body: walking, grasping, &c. These are performed by muscles. Secondly, we obviously *speak* by muscular aid. Thirdly, we *express our emotions* — from sneezing and snarling with our raised lip and uncovered tooth, to shrugging our shoulders—by means of muscles. Fourthly, we *circulate our blood* by muscular action, for the heart is simply a hollow muscle. And fifthly, muscle *helps in the digestion of food*, for the middle coat of the stomach and intestine, not to speak of the gullet, is muscular, and serves

by its movement to mix the food with the digestive fluids. I need hardly add that muscles give to the varied regions of the body their contour and outline. It is the business of the sculptor to delineate with precision the form which the various muscles give to limbs and body under the varying attitudes of action and repose.

There are two distinct classes or kinds of muscle in our bodies. The first of these is the group of *voluntary muscles*, whilst the second group is that of *involuntary muscles*. The former derive their name from the fact that we can move them when we like, and the muscles of face, head and neck, arms, trunk, and legs—that is, the muscles of the body generally—exemplify this first set. The "involuntary" muscles are those which are outside the command of the will, and which discharge various important duties, requiring, so to speak, automatic and regular performance. The muscles of the stomach, which, by their action, mix the food with the gastric juice; the muscles which form part of the walls of bloodvessels, and which by their contraction or expansion produce pallor or blushing of the skin for example; and the muscles of the bronchial tubes of the lungs, and of the pupil of the eye, all illustrate the "involuntary" class. They act only when stimulated by some special feature of life. Light will produce contraction of the special eye muscles whose function it is to close the pupil; and food entering the stomach sets its muscles agoing. The heart is likewise an involuntary muscle, discharging, when left to itself and not interfered with by the brain, its important duty with regularity and precision.

There is a wide difference in structure between the "voluntary" and "involuntary" muscles. The former are often called *striped* muscles, and the latter *unstriped*; but it must be borne in mind that the *heart* is an exception to this classification. The fibres of the heart are *striped* like those of the "voluntary" muscles, whilst, of course, the heart is entirely involuntary in its action. In some respects the heart-fibres, however, are different from those of the striped muscles at large.

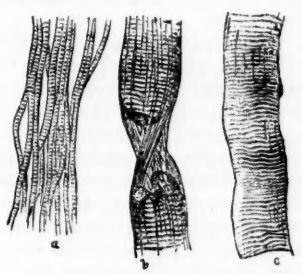

Fig. 1.

If we take a "voluntary" muscle, separate it from its surrounding neighbours, and examine it carefully, we find it to be composed of *bundles of fibres* or *fasciculi* as they are technically named. Each bundle consists of a variable number of fibres (Fig. 1. a.) which at their longest do not exceed one and a half inches in length. The average breadth of a fibre varies from the four-hundredth of an inch to the twenty-four-hundredth. In cold-blooded animals, the fibres are larger than in warm-blooded forms. When we put a fibre of voluntary muscle under the microscope, we observe that, as the light shines through it, it presents a striped appearance (Fig. 1. c.), the stripes running across the fibre. This "striped" appearance, from which the voluntary muscles derive their name, is due to the fact that a fibre is composed of two kinds of elements, thick and thin. These alternate with each other, and the thick parts, of course, under transmitted light, appear as the dark stripes, whilst the thinner parts form the intervening light bands of the fibre. The light bands refract the light singly, whereas the dark discs or parts refract the light in a double fashion. More recently, another stripe has been described cutting as it were, each dark stripe into two halves. It is evident, however, that when the ultimate structure of a fibre of muscle is considered, we might readily enough conclude that the fibre was really built up of cross-pieces or discs, placed end to end, like a *rouleau* of shillings. And, as a matter of fact, we can see this structure in a muscular fibre which has been allowed to soak for some time in a weak acid. As shown in Fig. 2, the fibre then breaks into cross-pieces, named its *discs* (*a*, *b*). Again, on the surface of the fibre we can detect markings or stripes running the long way of the structure. This shows us that in another sense the fibre can be divided into smaller fibres or *fibrils*; and when the extremity of a fibre is microscopically examined, we may see the ends of these fibres (Fig. 2, *c*), reminding us of a section of the separate wires which compose a thick wire rope. Last of all, we must note that each fibre is enclosed in a delicate sheath, called its *sarcolemma*.

Fig. 2.

The *unstriped* or *involuntary* muscles possess, as their name implies, a different structure from their striped neighbours. They are also composed of fibres, but each fibre is made up of long spindle-shaped cells, varying in length from the three-hundredth to the six-hundredth of an inch.

The question, finally, "how does muscle act?" faces us at the close of our brief studies. If we take the well-known *biceps* muscle, which forms the great fleshy mass of the upper arm, as a type of muscles at large, we may discover a ready reply to this question. The biceps springs from the shoulder by its two tendons (or sinews) and passes, to be attached or "inserted" also by a tendon, into the *radius* (one of the fore-arm bones) below. Now, when this muscle acts, we see that it pulls up the fore-arm and flexes or bends it on the upper arm, as in the act of bringing food to the mouth. If we place our hand over the biceps (at the middle of the upper arm) as we raise our fore-arm, we shall feel *the muscle to grow thicker* as the fore-arm approaches the upper arm. Again, we observe that only one end of the muscle moves (the lower end, or *insertion*), whilst its upper end (or *origin*) at the shoulder, remains fixed. From these facts, then, we learn, *firstly*, that muscles act by pulling together the parts between which they are attached; *secondly*, that the muscle grows thicker when it acts; and *thirdly*, that muscles perform their functions of moving the bones and body, because they possess an inherent property called *contractility*—that is, *the power of shortening themselves*. In this latter phrase is found the whole explanation of muscular action. And when we add that groups of muscles (such as those which bend the fingers), antagonise or oppose others (such as those which open the fingers); and that the muscles are ordered and governed by the nervous system, we shall have fairly started our readers on the way of becoming better acquainted from the pages of any physiology text-book with the interesting problem concerning our movements and the power of doing as we will.

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HAS THE MOON AN ATMOSPHERE?

To the Editor of Knowledge.

REFERRING to Captain Noble's recent interesting description of "thorns" on the cusps of the partially-eclipsed sun, it may, perhaps, be useful to record what photography has said on the subject. I have in my possession some nineteen heliographs (prints) of the eclipses of Dec. 22, 1870, and May 26, 1873. These are four and a-half inches in diameter, and when weather has been favourable, the definition is excellent, as shown by the details of sunspots and the indentations of the moon's edge.

They were taken by Mr. Fitterton, at Ely, and it is to be regretted the work is now discontinued.

I have also seven gelatine plates, taken by myself, of the eclipse of Dec. 31, 1880, which are fairly sharp, though not equal to Mr. Fitterton's. A careful examination of these prints and plates does not reveal any of the "thorns," but, I think, does, in one or two cases, show a tendency to blunting of the cusps.

These instances are, however, among the 1873 and 1880 photographs, when clouds and air disturbance have evidently somewhat blurred the outline. Those of December, 1870, were taken when the sun was high, and, as to six at least, under favourable circumstances. The cusps in these are wonderfully sharp and well-defined, and show neither "blunting" nor "thorns."

From the photographic evidence it would appear the "thorn" observations are rare; and, indeed, I have seen no instance myself. I can however confirm the marvellous sharpness of Saturn as it cut the moon's edge on the occasion Captain Noble refers to. So far in favour of the absence of moon's atmosphere; but one word now on the other side. Previously to the lunar eclipse of Feb. 27, 1877, Mr. R. A. Proctor referred in one of the public prints to its being formerly considered that the moon "perhaps was illuminated by auroral light." I did not see this passage till after the eclipse, but I did remark during that event on the "aurora-like" patches of light seen on the moon's disc; and in the eclipse of Aug. 23-24 of the same year I obtained what I considered strong confirmatory evidence of these patches. When these observations, supported as they were by the views of Professor Alexander, Professor Dorna, and others, were published, they met with less than encouragement; but now I am rather glad to find that the possibility of local cloud or mist on the moon (which could hardly exist without some form of atmosphere), is not only supported by observations, but accredited by some of our first selenographers. The inference from this appears to be that if our satellite has not an atmosphere quite like our own, she may have one, though rare enough to support auroral discharges, under some circumstances sufficiently dense to partly obscure and alter in character portions of her surface as viewed telescopically by us. J. Rand Capron.

Guildown, Guildford, *Dec.* 7, 1882.

[I read over with Mr. Russell, Government Astronomer at Sydney, New South Wales, Mr. Capron's arguments (in his larger work), and listened to Mr. Russell's own; but I must confess I see nothing in anything yet observed during lunar eclipses which is suggestive of auroras on the moon, or cannot be explained as naturally to be expected during lunar eclipses.—R. P.]

Now ready, Part XIV. of Knowledge (Dec., 1882), price 1s.; post-free, 1s. 3d.

Reviews.

LIGHT.*

THE science of optics is divided into two parts—geometrical and physical optics. They cannot be treated quite independently of each other, any more than the geometrical properties and laws of motion can be completely dissociated from the physical qualities and laws included under the general term Dynamics. But while in books on geometrical optics the propagation, reflection, and refraction of light, according to determinate laws, are chiefly considered, in a treatise on physical optics those effects are considered only as illustrating or establishing the laws according to which light is transmitted, deflected, absorbed, dispersed, and so forth. The book before us deals chiefly with physical optics, yet gives a sufficient explanation of those matters (usually dealt with in books on geometrical optics) which are essential to a right understanding of the nature and laws of light.

The work is one of the best of the excellent series of text-books of science published by Messrs. Longmans & Co. There is a careful reference throughout to the requirements of students not acquainted with the more advanced departments of mathematics. In fact, only a very small part of the work requires any knowledge of mathematics beyond the elements of plane trigonometry. Of course, the evidence demonstrating the existence of a something which we call the æther of space, but in reality only know of by its effects, could not be given in such a work as the present; for none but the mathematician can grasp the evidence, any more than non-mathematicians can grasp the reasoning of Newton in establishing the law of gravitation. Here, therefore, only the general evidence is given, just as in our works of astronomy all but the outline of the simpler parts of Newton's demonstration is omitted. But the undulatory theory of light, as distinguished from the theory of an æther, is fully established by the evidence considered here—which indeed runs through the whole work.

Chapters V., VI., VII., and IX., XII.–XIV., on "Interference," "Colours of Thin Plates," "Diffraction," "Spectrum Analysis," and "Polarised Light," are especially interesting. We would commend in particular the careful study of the chapter on "Diffraction" to those who wish to follow understandingly the work which is being done, and will hereafter be done in yet greater degree, with the diffraction spectroscope. We note with some surprise the omission of any explanation of Haloes, for the phenomena spoken of at p. 203 under that name are not Haloes at all.

There is a very interesting discussion in the last chapter of the various determinations of the velocity of light. We could wish that, besides the metric statements, measurements in miles per second had been given. To tell readers that the velocity of light *in vacuo* is 300,574,000 mètres per second is very well; but some readers, at any rate—say one in a hundred—would not infer *at once* that light travels, according to this estimate, at the rate of 186,771·4 miles per second.

NAT, THE NATURALIST.†

We are disposed to envy the boys of the present day—they have such capital books written for them. In our time "Sandford and Merton" was the type of book for boys,

* "Physical Optics." By R. T. Glazebrook, M.A., Fellow and Lecturer of Trinity College. (Longmans, Green, & Co., London.)

† "Nat, the Naturalist: or a Boy's Adventures in the Eastern Seas." By Geo. Manville Fenn. (Blackie & Son: London, Glasgow, Edinburgh, and Dublin.)

and with all respect to the memory of worthy Mr. Thomas Day, "Sandford and Merton" is occasionally rather wearisome, and the science in it is not always either plainly worded or exactly described. The fight between Harry Sandford and Master Nash seemed to us the best thing in the book—not because it was a fight (we trust), but because the bad fellow got well beaten. But Mr. Barlow, with his preposterous stories, was an emphatic nuisance most of the time, and so was Harry himself, too often. Tommy Merton was a good deal pleasanter, except for the short time when fine company and a silly mother spoiled him. Our modern writers of stories for boys seldom introduce a bore of the Barlow sort. They get their boys out into the open, and give them multitudes of exciting scenes —in fact, their worst fault (and it is not one of which boys are likely to complain), is that they represent travel in the woods, at sea, in arctic regions, and in the tropics, as a scene of constant adventure. There are no flashes of dulness, as in real travel.

The book before us is a capital book for boys. A lad with a taste for natural history, living with a kindly but rather weak uncle, and an aunt who sets a stern face against litter of all sorts, gets into trouble at home, culminating when he stuffs a grey parrot into the semblance of a "beast,"—a "regular guy." Then an uncle of kindred tastes appears on the scene, and the boy, after some preliminary lessons in shooting, boating, and so forth, goes with him to New Guinea, there to have his fill of collecting, adventure, and danger,—yet not absurdly lucky, as some boys we could name, in always meeting just such adventures as a traveller, after ten or twelve years in a place, would consider the most remarkable in his experience. Nor is our "Nat, the Naturalist" too murderously inclined. He peppers bloodthirsty Papuans with small shot, reserving his rifle-bullet for closer danger when danger seems almost at its closest. As in Mr. Manville Fenn's "Ship Ahoy!" dangers thicken at times till there seems no hope; but a way of escape is always found (we are not taking away the interest of the story in saying so much, for no boy hero that we know of was ever killed, at least in such stories as this—the boy on the burning deck don't count). The tone of the book is thoroughly good. The science is not rammed down the boy-reader's throat, but brought in naturally and pleasantly. The hero is not an impossible combination of courage, strength, agility, and keenness, but a boy who masters his fears after failures, and becomes active, strong, and clever by resolute work and watchfulness.

THE FACE OF THE SKY,

FROM JANUARY 5 TO JANUARY 19, 1883.

UNDER this heading we propose to point out, at intervals of fourteen days, such celestial objects and phenomena as are susceptible of observation by the amateur possessor of a portable achromatic telescope. Pending the completion of the stellar portion of "Nights with a Three-Inch Telescope," our references to objects of interest in the various constellations will be confined to those which have been previously described in these pages. It is further proposed to furnish a popular description of the lunar surface in a series of papers especially devoted to that subject. Hence, references to the moon will, for the present, be confined to notices of her age and position in the sky.

The sun should be examined every clear day with a power of 60 or 70, and an eye-shade of the tint known by the opticians as "London smoke" (or by one of the darkest blue or green procurable), as we are now passing through a period of sun-spot maxima, and the solar surface is diversified by spots and faculæ, some of the former occasionally assuming enormous dimensions.

To-night (Jan. 5), if it be (as is most unlikely) absolutely clear in the south-west horizon, Mercury may be caught twinkling close to it, immediately after sunset. The chief constellations visible after dark are Pisces, Cetus (KNOWLEDGE, Vol. I., p. 220), Pegasus, Cygnus (Vol. II., p. 310), Cepheus, Perseus (Vol. I., p. 221), Andromeda (*id.*), Cassiopeia (Vol. I., p. 445), Draco (Vol. II., p. 339), Ursa Major (Vol. I., p. 445), Ursa Minor (*id.*), Auriga (Vol. I., 313), Taurus (Vol. I., p. 221), Gemini (Vol. I., p. 376), Orion (Vol. I., p. 290 and 291), &c. The references we have given are to the places in which the chief objects of interest in the shape of double star and nebulæ in these constellations are described. For a general view of the night sky, however, the student may refer to the map on p. 206 of our first volume; from which, moreover, he will find the positions of the planets with considerable facility. Saturn is now a most interesting object, as his ring continues very slowly to open. The observer may scrutinise him with the highest power at his disposal. It is odd, and not very explicable, that this planet bears magnification notably better than its much more brilliant neighbour Jupiter. To-night, and for the next fortnight, Saturn will be found a little to the south-east of δ Arietis. Jupiter, to the north-east of ζ Tauri, is by far the most striking object in the sky; and will actually cast a shadow of any body interposed between him and a white surface. The now rapidly-fading great red spot and the white spot on his equatorial belt will claim the observer's attention. His first satellite will cross his disc this evening, itself entering on to it at 5 h. 30 m.; while at 5 h. 31 m. its shadow will follow it on to Jupiter's face. At 7 h. 18 m. the satellite will pass off, followed by the shadow at 7 h. 47 m. The same satellite will again exhibit a similar sequence of phenomena on the 12th and early morning of the 13th, when they will happen at 12 h. 22 m. p.m., 12 h. 57 m. p.m., 2 h. 37 m. a.m., and 3 h. 13 m. a.m. respectively. The student will note that Jupiter, having passed opposition, the satellites precede their shadows in crossing his disc. Before opposition the shadows were the first to enter on to his face. Prior to the transit of Satellite I. on the 10th, Satellite II. will have passed across Jupiter. Its ingress will occur at 5 h. 12 m. p.m., and that of its shadow at 6 h. 21 m. p.m. The egress of the satellite happens at 7 h. 56 m. p.m.; the egress of the shadow at 9 h. 7 m. p.m. The observer should carefully watch this phenomenon, since the shadow of this satellite has been seen of a chocolate or brown colour on Jupiter's disc, while that of Satellite I. has simultaneously appeared like a dot of ink. On the 11th Satellite I. will be occulted (*i.e.*, will pass behind Jupiter's disc) at 9 h. 30 m. p.m., as will Satellite III. at 10 h. 41 m. p.m.; at 19 m. 59 s. after midnight the first satellite will reappear, not from behind Jupiter's disc, but from eclipse in his shadow, a little to the right of and below the centre of his following limb (as seen in an inverting telescope). It will reappear at the same place from eclipse, at the much more convenient hour of 6 h. 48 m. 44 s. p.m. on the 13th.

As the moon pursues her monthly path through the sky, she, of course, passes in front of numerous stars, and as it is technically said, "occults" them. The disappearance and reappearance of a star at the moon's limb is a most interesting and curious occurrence, and we propose, in conclusion, to give the times at which some of these phenomena will be observable during the next fortnight. As the moon travels from right to left, of course, it is always her eastern limb at which a star disappears, and her western one at which it comes into sight again. Between new moon and full moon, however, this eastern limb is unilluminated, so that the star is extinguished with a suddenness that is quite startling. There is a conventional way of representing the points on the moon's limb at which disappearances and reappearances take place. It is this. A great circle is supposed to pass through the zenith and through the moon's centre, and the place where this circle cuts the apparent upper part of her limb (as seen in an inverting telescope), but what in reality, is her lowest point—this so-called "Vertex," we say —is taken as the initial point, and angles are measured towards the right hand round her circumference as seen in an inverting telescope. We may illustrate this by the aid of a florin, which we must turn as if it were upside down for the purpose; or, in other words, invert the legend. Then, supposing this to represent the moon as seen in an inverting telescope, a star occulted at any angle of 133° from the vertex will disappear at a point in the circumference between the "O" and the "n" in the word "One," and should it reappear at an angle of 327° will emerge opposite the "a" in the sentence "of a pound." With this preliminary explanation we may say that on the 11th c^1 Capricorni, a 4½ mag. star will disappear at the moon's dark limb at 6 h. 6 m. p.m., at an angle of 90° from her vertex, and reappear at her bright limb, at an angle of 25°, at 6 h. 39 m. p.m. On the 12th, the 5th mag. star κ Aquarii will disappear at the dark limb at 4 h. 52 m. p.m., at an angle from the vertex of 133°, and reappear at the bright one at 6 h. 0 m. p.m., at an angle of 327°. Occultations of 15 Piscium, 29 Arietis, and B. A. C., 1651, will occur on the evening of the 13th, early morning

of the 17th, and the night of the 19th respectively; but as these are all stars of less than the 6th magnitude, we give no details of them in so merely popular a list of occurrences as this.

The moon is 25·8 days old at noon on the 5th, is new at 5 h. 59·3 m. a.m., on the 9th, and enters her First Quarter 47·6 m. after midnight on the 15th. At noon, on the 9th, she will be 0·3 day old—1·3 day old at the same hour on the 10th—and so on. At 9 p.m. on the 5th, she will be in the constellation Scorpio; at the same hour on the 6th, in Ophiuchus; on the 7th, in Sagittarius; on the 8th, in the same constellation, as she will be on the 9th too; on the 10th, in Aquarius; on the 11th, in Aquarius also; as she will be on the 12th; on the 13th, in Pisces, which she will not quit on the 14th or 15th.

Venus attains her greatest brilliancy during the early morning of the 11th. She is a most conspicuous object in the south-east before sunrise; and but for her great South declination, and consequent proximity to the horizon, would be visible to the naked eye in sunshine.

Our Paradox Corner.

A THEORY OF MERCURY.*

By Thomas Foster.

I FEAR that many—perhaps including the editor—will consider me entirely out of order in venturing, though not an astronomer, to advance an astronomical theory. I have discussed (see "Leisure Readings," Knowledge Library, Vol. V.), illusions in these pages, and elsewhere the probable British origin of a large part of our English blood, the true plot which Dickens had in view in the "Mystery of Edwin Drood," and other such subjects. I have advanced a theory as to "Nature Myths in Nursery Rhymes," which some critics unkindly regarded as a jest, while others have, in solemn sort, denounced the theory as profane in the first place, and incorrect—which is a trifle, however (as you would say) in the second. It would be very distressing to me if any one should for a moment imagine that the astronomical theory I am about to describe is advanced in jest, or is the invention of some light and trifling hour and mood. It has, I beg most earnestly to assure my readers, been carefully compared with many of the theories, scientific and otherwise, which have been advanced during the last few years. It has not been adopted until I had satisfied myself that in its chief characteristics it will bear favourable comparison with some, at least, among those theories. After adopting it I have, indeed, (as is only natural), most sedulously nursed and fondled it, until I have become warmly attached to it. It would, in point of fact, be incorrect to speak of it as an adopted theory, if by that were to be implied that it is the offspring of any other brain than my own. It may be—astronomers I know will say it *is*—"a poor thing," "but," as Touchstone says, with a touching pathos (often misapprehended), "it is my own."

I must confess, let me say at the outset, I am not prepared to accept as just the objections with which astronomers and other men of science seem disposed to regard all attempts on the part of persons outside their ranks to form an opinion about the results of scientific observation. If we are not to theorise about the wonders of which they tell us, it can only be because they have not well explained their meaning. This, indeed, is likely enough; for most of them are, unhappily, inarticulate. Like the Cyclops of old, they are single-eyed (for as yet binocular telescopes are not in use), but some of them speak so indistinctly when they condescend to speak at all, that they would seem to have a double tongue. However, it must sometimes happen that what they have to say is so plain and simple in itself, that it can hardly be expressed indistinctly. There are limits even to the use of technical expressions; and even where technical expressions are available, it will sometimes happen that by an accident a man of science, through a momentary lapse of attention, will use words that the unscientific can understand. Learned medical men have been known to speak (when hurried, of course) in plain terms,—to talk of a black eye, for example, instead of indulging in the customary references to extravasation, ecchymosis, and so forth. And again, though it is, I believe, considered *de rigueur* by your true scientist to speak of colours as "belonging to the more or less refrangible end of the spectrum," when one means that they are blue, indigo, and violet, in one case, or red, orange, and yellow in the other, yet we do sometimes hear a man of science by mistake speak of blue, red, or green, as the case may be, like other people. The case which I am going now to discuss is an instance in point.

Before proceeding, however, directly to my theory, which relates, let me here mention, to the planet Mercury, I may say, generally, that there appears to me something narrow, and, one might almost say peevish, in the attempt made by too many astronomers to restrict our ideas about other planets or suns by what we know about our own earth and about our own sun. Better, as it seems to me, to indulge even in the freedom of imagination, the unscientific licence, some would say, which gave birth to the green-cheese theory of the moon and to other views not, perhaps, absolutely defensible, than to be restricted within the narrow limits of the known. Even men of profoundest scientific knowledge have admitted that "the known is little, the unknown is immense." Where the field is so wide for guessing, why strive to keep the thoughtful student of scientific wonders confined painfully within the narrow field of the known? If we cannot enlarge our knowledge as we could wish, let us at least boldly widen our conceptions. If we cannot prove the verdant caseity (or the caseous verdure) of our satellite, let us not, therefore, be deterred from imagining that in that remote world a state of things may exist of which we terrene creatures, "limited little brutes" as we are (I thank thee, Miss Bella Wilfer, for teaching me that word), can have but very imperfect conception or no conception at all.

(*To be continued.*)

* Mr. Foster must excuse our relegating his ingenious theory to Paradox Corner.

"Let Knowledge grow from more to more."—Alfred Tennyson.

Letters to the Editor.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to, delays arise for which the Editor is not responsible.

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THE FELLOWSHIP OF LEARNED SOCIETIES.—MEASURING THE POWER OF AN EYE-PIECE.

[674]—There are two of your "Answers to Correspondents" with reference to which I should like to make a few remarks. The first is that to "D. Q. J." (p. 500), concerning the Fellowship of the Royal Astronomical Society, into which, as you but too truly intimate, anybody can get who can obtain two or three people to nominate him, and can afford to pay the fees. What is the consequence? Simply that the proprietors of middle-class schools of a particular type, who want to write "F.R.A.S." after their names in their advertisements, are perpetually being elected; albeit their knowledge of astronomy may be represented in many cases, algebraically speaking, as a − quantity. Speaking for myself, I think that our bye-laws should be altered so as to include some intellectual test among the qualifications for Fellowship. A knowledge of the chief numerical details of our own solar system; of the first six books of Euclid; of the rudiments of algebra, trigonometry, and the power to use a table of logarithms, would not be a desperately severe criterion of fitness, and might spare us the scandal of any of our *confrères* advertising themselves, *totidem verbis*, as "eminent astronomers," and compiling books on astronomy; when they could not solve a common quadratic equation (to say nothing of summing a convergent series) to save their souls alive.

In the second place, I merely wish to say that the instrument concerning which "H. S." (p. 500) has put a question is obviously the very simple dynamometer invented by the Rev. E. L. Berthon, of Romsey, Hants.

A Fellow of the Royal Astronomical Society

BRIGHT STAR NEAR THE SUN.

[675]—With reference to the phenomenon mentioned on p. 489 of KNOWLEDGE, as having been seen on Dec. 21, if the object was not a comet near perihelion, it was probably a temporary star. I find there is no bright star near the place, the nearest being ϵ and σ Sagittarii (of the 2nd mag.), each about 12° distant; but these would be south of the sun, and not "a little above the sun's path," as the description states, besides being quite too faint to be visible in the daytime (to the naked eye) under any circumstances. The object could not have been the planet Venus, which was situated about 23° west of the sun on the day in question. It seems worthy of remark that the place of Kepler's celebrated "Nova," of 1604, was—at the time of observation—only about 8½° to the west (and a little north) of the sun's place. So that, if the object was really a star, it seems possible that it may have been another outburst of Kepler's star. The morning sky should be examined, as, if the object be still visible, of the same brilliancy, it should now be a conspicuous object before sunrise. J. E. GORE.

Ballisodare, Co. Sligo, *Dec.* 30, 1882.

THE AURORA BOREALIS.—THE RAIN-BAND SPECTROSCOPE.

[676]—I think there can be no doubt in regard to the connection between the "torpedo-shaped," "cometary," or "herring-without-price body" that was seen on Friday, Nov. 17, at 6.5 p.m., and the aurora, as the spectroscopic examination gave the same bright line for both; and this was situated between D and E in the spectrum, but nearer the former. Upon a previous occasion, when observing the aurora of Oct. 2, I noticed a bright line in a similar position, and for a few minutes only three distinct bright lines in the red end of the spectrum. By-the-by, since sending those hints about the use of the rain-band spectroscope, that appeared in No. 53 of your valuable periodical, I have made the discovery that with small looking-glasses, placed at suitable angles outside the window, the light can be reflected, apparently with very little loss, into the room, and then examined with the spectroscope for percentage of rain-band. For zenith observations this plan will be found extremely useful, and moreover enables an observer to examine the greater part of the sky in any weather, without straining to look round corners, or having to go outside the house. I do not know whether you will consider this worth mentioning in KNOWLEDGE, but I have certainly found it in practice of great assistance in the spectroscopic examination of the air. F. W. CORY, F.M.S.

Buckhurst Hill, Essex, *Nov.* 30.

TRANSIT OF VENUS.

[677]—The day of the transit was most unpromising. Heavy showers fell early in the morning, and during the day the sky was dotted with fleecy clouds which were continually crossing the sun and impairing definition. I took up my position at the telescope several minutes before external contact; but, on account of the clouds, I did not see the planet on the sun's disc until more than a minute after external contact had taken place. As Venus advanced on the limb of the sun, I had to be continually shifting the tinted wedge in order to keep the field of a constant brightness. When the planet had advanced about three-quarters on to the sun, the brightness increased rather suddenly, and I saw the outer limb of Venus surrounded with a beautiful halo of white light. At the same time the cusps appeared to be slightly blunted and bent outwards. As interior contact approached, the sun cleared, and, in a moment of good definition, I saw geometrical contact at 15h. 24m. 39·3s., Barbados sidereal time. Immediately after this clouds passed, and it was impossible to say at what instant the connection was severed. Mr. Talmage, who is the other observer here, was more fortunate, and observed the actual moment of separation free from clouds. He gives the time at 15h. 24m. 43·8s. Barbados sidereal time.

At Egress the sky was clearer, and I was able to observe the time when the first shadow formed between the limbs, which was 20h. 50m. 39·6s. Barbados sidereal time, and the time when the ligament became as dark as the disc of the planet, which was also the time of geometrical contact, namely, 20h. 50m. 53·6s. B.S.T. Mr. Talmage's observation for the latter phase was 20h. 50m. 59·1s. B.S.T. The same phenomena were observed at egress as at ingress, only the halo did not extend completely round the planet. It extended very much further on the north side of the limb than on the south. The blunting of the cusps was not quite so marked. Exterior contact was very good. My time was 21h. 11m. 30·6s. B.S.T. Mr. Talmage gives 21h. 11m. 26·1s. B.S.T., but does not consider his observation very good. The discrepancies between our observations may seem large to those who have not seen the transit, but it must be remembered that the motion of Venus is very slow, and that the phases are by no means instantaneous. I believe that the times are largely affected by the brightness of field employed, and it is impossible to obtain exactly the same brightness for different observers. I saw no satellite, though I searched for one at intervals throughout the whole transit. I employed a six-inch equatorial by Simms, and Mr. Talmage employed one of a similar aperture by Dollond. The glass of the latter is about the best of its size which I have seen. J. H. THOMSON, Lt. R.A.

Barbados, *Dec.* 6, 1882.

THE DIAL OF AHAZ.

[678]—In two church lessons, the second (or fourth) Book of Kings, c. xx. and Isaiah, c. xxxviii., a perfectly unique "sign" is described as given to Hezekiah in his sickness, when he had inquired "What shall be the sign that the Lord will heal me, and that I shall go up into the house of the Lord the third day?" It is also very briefly mentioned in 2 Chronicles, c. xxxii. v. 24, as a well-known event, with the further information that Merodach-Baladan's embassy, which both accounts record soon after, came to inquire (among other things) about "the wonder that was done in the land."

In the fullest account and first as they now stand, which I find to be also the most accurate, and, doubtless, earliest, we find the sick monarch offered this choice:—"Shall the shadow go forward ten degrees, or go back ten degrees?" The advance or recession, whichever he chose, were plainly to be of one identical angular measure, pre-announced, and which was some aliquot part of either a quadrant or the semi-diurnal arc, whichever the diallers of that time used to divide. "And Hezekiah answered, It is a light thing for the shadow to go down ten degrees; nay, but let the shadow return backward ten degrees." He evidently thought, before seeing either, that the return would be the more marvellous; but, in fact, either the sudden shifting back or sudden advance are equally strange and out of human power; indeed, so uncommon are both phenomena that I should be rather more surprised if the records of any Observatory or Royal Society kept for 1,000 or even 5,000 years, related a single instance than at their relating none.

Happening to know, however, of an afternoon some years ago in which both did certainly occur, I have thought that possibly some reader of KNOWLEDGE may have witnessed, and can describe the facts. There are plenty of sun-dials in southern England whereon I know (but did not till years after the occurrence) that the "wonder" was repeated exactly as Isaiah described—I mean in the earlier and fuller account, *not* in our present "Book of Isaiah." If none happened to see the shadow shift, I shall willingly explain how I know that both the signs offered were certainly that day visible. E. L. GARBETT.

[I should feel greatly obliged if Mr. Garbett would describe the phenomena he observed, and give his interpretation of it.—R. P.]

ELECTRICITY IN DENTISTRY.

[679]—It is a fact that electricity has been tried as a means of deadening the pain during tooth extraction. Mr. Snape, of Liverpool, was, I believe, the dentist who brought the system most prominently forward, and adopted it in his own practice with some success. It was found, however, in many cases that the pain occasioned by the shock was greater than that of the simple operation. The system therefore met with but little favour, and though one, at least, of the manufacturers of dental appliances included the battery and insulated forceps in his catalogue, there are probably very few indeed in the profession who have tried it. My own idea is that it might be applicable in the extraction of *dead* teeth, *i.e.*, teeth in which the nerves are dead; but where the pulp or nerve is living, the shock would doubtless be excruciating.

We find for the same reason that the local application of æther is not practicable except in the extraction of *dead* teeth and stumps.

JOHN TRUDE FRIPP, L.D.S.I.

LUMINOUS PAINT.

[680]—It strikes me there is an error in the article on "Luminous Paint," where it states that "the light given off will not affect the most sensitive photographic plates." The fact that it is very largely used by photographers as a standard light to test photographic gelatine plates cannot be known to the writer.

ALEXANDER COWAN.

CORSET WEARING.

[681]—Where "E. H." remarks that there is about three times as much breathing-space in the lungs as is needed for ordinary

respiration, I suppose he means that only about one-third of the contents of the lungs are changed for fresh air in each ordinary act of respiration. True, but it does not follow from that that the lungs are doing nothing with the two-thirds balance. On the contrary, all that balance of air is obeying meanwhile the law of *diffusion of gases* (in this case the interchange of oxygen and carbonic acid, &c.), and the larger the amount of air, and the greater the space in the lungs, the more rapidly and perfectly is that all-important interchange effected; so that large lungs are a desirable possession. E. D. Girdlestone.

A CURIOUS CHRISTMAS.

[682]—A rare phenomenon was observable (*viz.*, outside window condensation) on Christmas day. The outer air was so warm compared with that of the interior of our houses that in all rooms where there was no fire burning the window panes were cold enough to condense the aqueous vapour of the saturated outside air, and were therefore densely bedewed *outside*.

This only happens with a sudden rise of temperature such as rarely occurs on Christmas day. W. Mattieu Williams.

Answers to Correspondents.

A Country Clergyman. It is very difficult to advise. A telescopist gets an instrument that suits him, and sticks to that; so that he can say little about other instruments. It is well, however, to be on the look-out for advertisements of second-hand telescopes by known makers.—M. Beyfus. Think there must be some mistake; will ask Mephisto.—W. Lance. Spectroscopic analysis shows coma to possess inherent light, and that even parts of tail do also.—C. J. T. (1) Do not think Ruskin's description agrees with the observed phenomenon. (2) Taking what is said on p. 107, table on p. 106 agrees with Young's. It gives the *ecliptical* diameter, not the equatorial. For screen-work only true at solar noon, unless screen carried by telescope driven equatorially.—W. G. By observation of Mars—not a new method—described in my little book on Sun, and in many other places.—XXX. Velocity less at return; would be the same if there were no air, but effects of atmospheric resistance throughout flight all tend to diminish velocity.—A Builder's Son. Putting the boards apart will make very little difference. It is found, for instance, that the driving force of the wind on the present divided topsail, though rather less than on a single topsail of the same area, is not so much less as to indicate greater loss than corresponds to the diminished area presented when the two sails belly. A parachute, again, has greater sustaining power when a hole is pierced in the centre, though that is due to steadied descent and diminished jerking.—George Clements. Remember how those triple kites used to pull.—Psychomantis. Thanks; we quote the passage in Gossip. As to Comet, it was very bright in Australia then; but its course indicates anything but constant proximity to the sun.—H. Peacock. Ajax not so generally known. Diffractive effects curious.—Cosmas. Thanks: would insert, but matter to same effect already in type. You seem to overlook the real analogy between the strength of wrist or knee muscles, and the strength of waist muscles, which was all we suggested. The question of the interior organs is, of course, much more important. We cannot understand your doubting whether the subject should find place in a scientific journal. Is a knowledge of our own bodies, and what is good for them, not science?—H. W. B. B., A Churchman. It depends much on individual tastes; but certain customs—the use of ancient verbiage, the wearing by clergymen of out-of-date costumes, and so forth—seem to imply that religious teaching, to have influence on the many, must always be more or less behind the age—more in some churches, which actually use a dead language, less in others, which only use old-fashioned speech. I personally have this peculiarity (I suppose it is) of mind, that I *must* see such things as they are, free from associations with antiquity, or with recollections of my own past (especially my own childhood), free, in fine, from all false lights, before I can satisfy myself as to their value. The very points on which Cardinal Newman dwells are among my strongest reasons for objecting. Not one in a hundred is at the pains to ask how much the effect of certain words is due to their intrinsic value, how much to the influence of association. Surely feelings so excited have no more specially religious significance than those which move the mind when the music of old home days is heard again, or when the quiet loveliness of a spring morning or an autumn evening stirs the heart with thoughts of days that are past. I do not say that we should analyse such feelings and emotions; I prefer, for my own part, to yield to their influence. But it does seem to me essential that we should not mistake these in reality sensuous effects for religious fervour. The soothing influence of the word Mesopotamia on the old woman of a familiar story was, we know, akin in her mind to a devotional feeling. No one would wish to deprive her of the soothing effect; but she might as well know how little of religion there is in it.—C. Carus-Wilson, Wm. Simmons, E. C. Thanks; but no space.—Ed. Robinson. It is so far true that no conceivable advance of science could take us back to the actual beginning of existent things.—Blackfriars. Rest you merry, sir; and, Rest you, merry sir: your effort to be merry deserves it. The passage runs, "Where got'st thou that goose look?" Perhaps you can say.—W. R. Eys, notes that the publishers of l'Abbé Moigno's works are Gauthier-Villars, 55, Quai des Augustins, Paris.—C. R. Haines. (1) In a scientific sense, Edgar Poe's "Eureka" is almost without value. (2) The earth's *orbit* has not shifted owing to precession; the position of her equator has; but the dates in question would not have been sufficiently altered since the cold spells were noted, to modify a relation which is, any way, rather rough.—E. Gurvey. Have asked for address.—J. H. Green. Every tail would be straight if that theory were true; but straight tails are the exception.—G. Harrison. Experiments by Pasteur on Hydrophobia will shortly be quoted.—A. A. Hartley. How does a cinder reflect light? Why should not the moon?—H. J. W. Thanks. Do not know where Griffin's excellent treatise on Rigid Dynamics obtainable.—X. Y. Z. You are right; that old mistake should have been corrected.—W. P. Nevins. Thanks.—A. S. Woodward. Fear could not find space at present.—M. J. Harding. Have heard nothing about "Half-Hours with Telescope," since it was published in '68.—C. R. Passage would doubtless interest many.—H. J. Muirhead. Subject dealt with in article in *Cornhill* recently.—W. E. Collard. Subjects too wide for brief answers here.—Samson. Can hear of no wooden dumb-bells. A turner would make them.—W. Morgan. Thanks; most conclusive.—D. C. Snape. Thanks; forwarded to electrician.—A Young Man. Thanks.—V. E. A. The series cannot be summed either to n terms or to infinity.—R. Jefman. Thanks; but British Israelism is not an inviting subject.—E. S. B. Is not the 10th nearer the middle than the beginning? I should understand by "early in May," a time within the first week. Thanks, however, for your note. Perhaps I wanted an excuse for saying how much I enjoyed the "Golden Butterfly."—W. G. Draper. Thanks. The case is curious; but explicable as a coincidence. There are so many dreams, and so many deaths, that sometimes the right death must be dreamed about.—"Tiehoot." The telescope will bear a power of 3,000. In point of *size* the moon can be seen as if nearer than Mount Everest from your observatory. But all atmospheric effects being magnified in like degree, there is nothing like the same distinctness.—L. W. Hutchings. Many thanks; but several object to much space being given to such narratives.—J. O. Lindsay. Many thanks.—Pleiades. Astronomy would be rather too severe for mental exercise. Easy geometrical problems would, I think, be useful, especially for out-door thinking.—D. Dodd. Hopelessly untenable.—E. R. C. No reason whatever for associating the comet of 1882 with Abraham's comet. By the way, which *was* Abraham's comet?—Physician. Short articles of that kind would probably be very acceptable.—J. G. Ashworth. Thanks. Evidence of the kind already in type. "An Observer" is *not* interested in the sale of corsets. I am only free to say that he is one whose opinion on any subject whatever must be well weighed and well worth weighing, albeit I think he is mistaken in this matter.—A Student. As to Star in the East, see No. 61; as to perihelion theory of world's end, it is all rubbish—

"One half of it ignorance, t'other half rum."

—F. W. Reynolds. Photographic perspective often monstrously wrong. I have seen photograph of interior of a Pullman car looking at least 300 feet long—the result of relative increase of parts remote from centre.—Wm. Nullar. Without wishing to be dogmatic, or even positive, I think I may confidently say that the spot you saw on the sun was a sun-spot, not a planet in transit.

ELECTRICAL.

Semper Eadem. Bunsen or Grove.—Ignorance. 1. It depends upon the resistance of the battery, and the work to be performed. 2. Presuming that the circuit will not be a long one, No. 20 copper. 3. No. 14 or 16. 4. It is immaterial for electrical purposes whether the conductor be in the ribbon or wire form, providing equal lengths contain equal weights of similar metal. 5. You get no shock, because the resistance of the body is very considerably higher than the electro-motive force of the battery. 6. Only by measurement, but approximate values may be found with good galvanometers, wound with coils of thick and thin wire. 7. "When you pass a spark through vacuum there is combustion. What is burnt or consumed?" You cannot pass a spark through a vacuum, and where there is no matter there can obviously be no combustion.

Our Mathematical Column.

NOTES ON EUCLID.

By RICHARD A. PROCTOR.

I HAVE often wondered that among the various attempts to correct the obvious defects—for educational purposes—of the use of Euclid as a text-book of mathematics, nothing should have yet been done to remodel the book itself. Various writers have published books of geometry, each fondly hoping that his book will not only displace Euclid, but dispose of all rivals. The result has proved rather confusing. A boy who has been at a public school where one of these books has been used, goes, perhaps, afterwards to a private tutor who prefers another text-book of geometry; thence, perhaps, to a London college, where yet another book is employed; and finally to one of the Universities, where he finds Euclid still holding the place of honour.

Now, if Euclid simplified could be put into boys' hands at school, and all other text-books diligently eschewed, there would be a common system at all schools, and no trouble when the old-fashioned Euclid was taken up, at whatever stage of mathematical progress.

There can be no doubt Euclid perplexes many boys, and disgusts not a few. For my own part, though I was introduced to Euclid in the absurdest of ways, I loved him from the beginning. I had been counted rather a dullard at Geometrical Exercises, which I disliked, because there were Rules without Reasoning. Just as the foolish arithmetics of those days told us in hard words what to do, but never showed us why, so the Geometrical books told us to rule this line and describe that circle, in order to bisect lines, set up perpendiculars, and so forth, with no proof that the methods were sound. Besides, while mapping (a most instructive exercise) I had intuitively invented such methods for myself; so that rules had not even the charm of novelty. At this stage of my progress—or want of it—a preposterous under-master pitchforked me into a higher class where Euclid was read, and where, as it chanced, the 16th Proposition of the First Book was in hand. It was a new thing to me to find reasoning about matters geometrical. Theoretically, the folly of putting me at the 16th Proposition *first* ought to have made Euclid hateful to me; but, as a matter of fact, the case proved otherwise: I loved him from the first. I read, alone, the Definitions, Axioms, and preceding Props.; then went along with Props. ahead; till, before very long, I was in the Spider's Web of the last Prop. but one of Book XII. Yet I was by no means a sound, only an eager, student of Geometry; for I remember devising a new construction for that most delightful of all Props., the 10th of Book IV., which, though much shorter and easier than the original, laboured under the slight defect of being incorrect.

Still, I think my case was exceptional. Most boys do not take kindly to Euclid, and certainly there is much in his outer appearance which is not inviting. In particular, the method of first giving the abstract proposition, and then describing a particular case, tests somewhat painfully the young student's power of attention. It is so much harder to make out what the enunciation means than it would be if each part were explained, as in the opening words of the proposition, that we cannot wonder if boys are bewildered and wearied. To the more advanced this is perhaps the real charm of Euclid—to note how each enunciation has the qualities of a good definition in precisely indicating the abstract idea without any reference to a special case. But Euclid was not writing for boys.

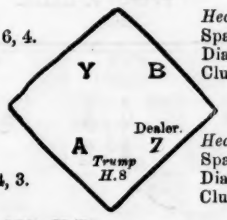
Again, there is a charm in the skill with which Euclid, having adopted a certain method, gets over the difficulties involved in applying that method to particular cases. The famous *Pons Asinorum* is a case in point. Euclid's plan will not allow him to use the bisector of the angle B A C, because he has not yet shown how that bisector can be drawn. Nor can he allow himself to suppose his initial figure, repeated line for line, and then applied, after being turned over, to the original figure, after the manner already employed in Proposition IV., because he has not yet shown how the "copy" is to be made. Either method would have given him a very simple proof, and as it is certain that there *must* be a line bisecting the angle B A C, and again that another figure precisely like that already drawn is conceivable (in the same sense that a straight line or a circle is conceivable from its definition), he was, logically, free to employ either plan. But he had assigned himself certain limits, and he makes out his proof within those limits very ingeniously and prettily—though confusingly to many boys.

(To be continued.)

Our Whist Column.

By "FIVE OF CLUBS."

THE HANDS.

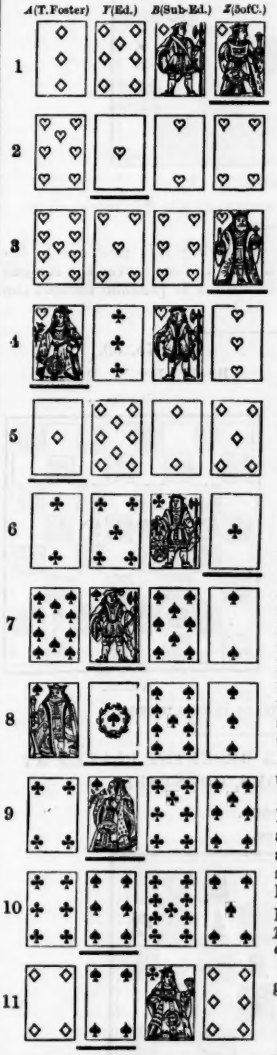


Y.
Hearts—A, 5.
Spades—A, Q, Kn, 6, 4.
Diamonds—9, 8, 7.
Clubs—10, 5, 3.

B.
Hearts—Kn, 6, 2.
Spades—9, 8.
Diamonds—Q, Kn, 2.
Clubs—K, Q, Kn, 9, 7.

A.
Hearts—Q, 9, 7.
Spades—K, 10.
Diamonds—A, 10, 4, 3.
Clubs—8, 6, 4, 2.

Z.
Hearts—K, 10, 8, 4, 3.
Spades—7, 5, 3, 2.
Diamonds—K, 6, 5.
Clubs—A.



THROWING AWAY WINNING CARD OF PARTNER'S SUIT.

THE PLAY.

Score:— $\left\{ \begin{array}{l} A, B, = 0 \\ Y, Z, = 0 \end{array} \right.$

NOTES BY FIVE OF CLUBS.

NOTE.—The card underlined wins the trick, and card below leads next round.

1. *A* leads from his best suit.

2. Having five trumps, *Z* leads the penultimate.

4. The third round is fortunate for *Y Z*. *Y* discarding a Club, and *A* having led Diamonds, *Z* knows that his partner's suit must be Spades.

6. *A* knows this also, and therefore leads Clubs. It would have been better, as it turned out, if he had kept to his own suit.

7. *Z*, having four cards of his partner's suit, leads the lowest. *Y* finesses the Knave, of course.

8. *Z*, noting the fall of the cards, perceives that his Seven will be in his partner's way. For neither *A* nor *B* have any more (*B* certainly not holding the Queen, or he would not have let *Y*'s Knave make at trick 7). Thus, if *Y* leads Queen at trick 9, and *Z* throws his Five, he will have to take the fourth trick in Spades, and a trick in Diamonds will go to the enemy.

9. *Z*, therefore, throws his Seven to *Y*'s lead of the Queen. But *Y* should not have led the Queen. He can count the Spades as well as *Z*, and knowing the second best and a small one was with *Z*, he should have led the Four, to make his partner's play as simple as possible. *Never leave to partner a point of strategy which you can attend to yourself.*

10, 11, 12, 13. The rest of the game plays itself.

VORTICOSE.—*A* leads King; *B*, his partner, holding Queen and small ones, knows *A* has led from Ace, King; if *B* shows this knowledge by extending his hand to take up the trick before *Z*, fourth hand, has played, is there any penalty? None; but if *B* is in the *habit* of doing such things, you should avoid playing with him.—FIVE OF CLUBS.

XUM

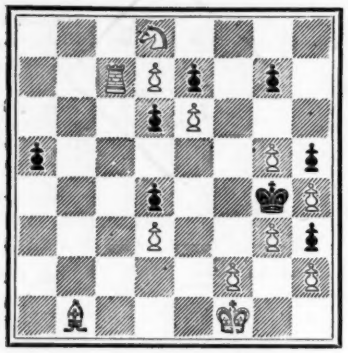
Our Chess Column.

By Mephisto.

PROBLEM No. 67.

By Francis J. Drake.

Black.



White.

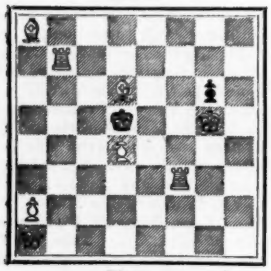
White to play and mate in four moves, also in five moves (conditionally).

We hope to facilitate the task of solving this problem, by informing our readers that to effect a mate in four moves the Knight must be moved, but a mate in five moves is possible without the Knight being moved from Q8.

No. 68.

By W. Jay N. Brown.

Black.

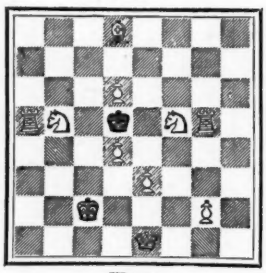


White.

No. 69.

By W. Jay N. Brown.

Black.



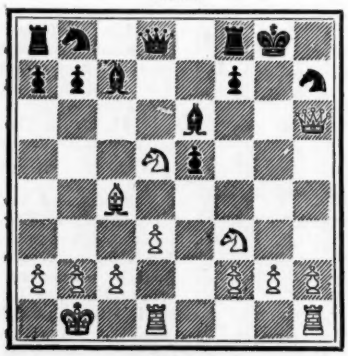
White.

White to play and mate in two moves.

END POSITION OF A GAME RECENTLY PLAYED AT PURSSELL'S ROOMS, CORNHILL.

Amateur.

Black.



White.

Mephisto.

White played 1. P to KR4, threatening to get a mating position by Kt to Kt5. Black, therefore, could not reply with B takes Kt, but played 1. P to B3, thinking thereby to prevent Kt to Kt5, for which purpose, however, the move was ineffective. B to B4 would have proved a better defence. White played 2. Kt to KKt5, threatening mate, and also Kt takes B, which would likewise win easily, so that Black could not play otherwise than 2. P takes Kt. 3. P takes P again, threatening mate. 3. Q to Q2. 4. P to Kt6. The Knight cannot be saved, as White threatens Q to R8, on the Black Knight moving: there seems nothing better for Black to do than 4. Kt to QB3, upon which White replied 5. Kt to K7 (ch), 5. Q takes Kt. 6. B takes B (ch), 6. K to R sq., and White mated in two moves.

SOLUTIONS.

Reprint No. 1, p. 473.

1. R to Kt4	1. Kt takes R
2. Kt to B3	2. Kt to B3 (ch)
3. Kt takes Kt mate.	

Reprint No. 2.

There are two solutions to this problem, viz.:—

1. R to QR5	K to Kt3		
2. B to B2 (ch)	K takes R or	2. B to Q6	P to Kt6 (best)
3. K to Kt7	P to Kt6	3. R to R8	K to B3
4. B to Kt6 mate		4. R to R6 mate.	

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

B.—You are right. In the game on p. 501, Black's 21st move is K to B5.

M. Beyfus.—We shall make inquiries about the pairing of players in the tournaments abroad. If, however, your object is to gain practical information on the subject, we advise you not to adopt the all-round play system, which is too long, the same as the knock out system is too short. Divide your team in as many sections as you have prizes, one or two games to be played by each man, the winners of the sections to compete for the prizes. This system of playing tournaments avoids (the fatality of) fixed appointments, as each man can play with any other man of his section whenever he meets him.

John Blain.—The Steinitz Gambit is given in "Gossip's Theory," p. 255. If Black replies with B to B4, then P to B4 is good, and if Black plays 3. P to Q3, you have the "Gambit declined" position.

Leonard P. Rees, J. Vincent Elsden, G. W. Mitchell.—Problems received with thanks.

R. J. P.—You have evidently missed one of the prettiest variations, where the Kt on Q2 comes in. What is your reply to Black playing 1. Kt to B5?

G. H. T.—Game will be annotated; other contents noted.

Correct solutions received of Problem No. 64, G. W. Francis, J. Drake. Reprints.—Berrow, H. V. T., H. Jacobs. No. 66, H. V. T., John Blain, Berrow, W. F. W. Rees, T. T. Dorrington.

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